We Claim:

1. Monodispersed, spherical zirconia (ZrO_2) particles of approximately 10 to approximately 600 nm, which exhibit metastable tetragonal crystal structure at room temperature.

2. The ZrO_2 particles as in claim 1, wherein said particles are approximately 10 to approximately 30 nm.

3. The ZrO_2 particles, as in claim 1, wherein said particles are approximately 500 to approximately 600 nm.

4. The ZrO_2 particles, as in claim 1 wherein the ZrO_2 particles are approximately 100% in the tetragonal phase at room temperature.

5. The ZrO_2 particles, as in claim 2, wherein the ZrO_2 particles are approximately 100% in the tetragonal phase at room temperature.

6. The ZrO_2 particles, as in claim 3, wherein the ZrO_2 particles are approximately 100% in the tetragonal phase at room temperature.

7. The ZrO_2 particles, as in claim 1 wherein the particles are pure and free of foreign oxides.

8. A method for the synthesis of monodispersed, spherical ZrO_2 particles, which exhibit approximately 100% metastable tetragonal structure at room temperature, of sizes of approximately 10 to approximately 600 nm, in powder form comprising the steps of:

mixing zirconium-alkoxide and an alcohol, forming preparation one;

separately dissolving completely de-ionized water and a polymeric steric stabilizer in an alcohol forming preparation two;

mixing the preparation one and the preparation two for approximately a few minutes while subjecting the mixture to hydrolysis and condensation reactions with very slow stirring;

waiting for the formation of a sol from the mixture;

drying at approximately 80 degrees C to form resultant material; and

crushing the resultant material.

9. The method, as in claim 8 wherein said polymeric steric stabilizer is an organic polymer containing -OH or ether group.

10. The method, as in claim 8, wherein said polymeric steric stabilizer is one of the group consisting of hydroxypropyl cellulose polymer (HPC), polyvinylalcohol, ethylene glycol, and hexamethyldisilazane.

11. The method, as in claim 8, wherein said zirconium-alkoxide is zirconium (IV) n propoxide and said alcohol is anhydrous alcohol.

12. The method, as in claim 8, wherein said synthesis takes place under normal atmospheric conditions.

13. The method, as in claim 10, wherein said polymeric steric stabilizer is HPC polymer.

14. The method, as in claim 13, wherein said HPC polymer has a molecular weight of approximately 80,000 to approximately 1,000,000.

15. A method for preparing monodispersed, spherical ZrO_2 particles comprising the steps of:

dissolving equal parts of an alcohol solution using an R-value of 5 to get approximately 500 nm ZrO_2 particles and R-value of 60 to get approximately 10 to

approximately 30 nm ZrO_2 particles, wherein said R-value comprises the ratio of molar concentrations of water to a zirconium zirconium-alkoxide;

adding a polymeric steric stabilizer and stirring over time forming solution one;

dissolving the zirconium-alkoxide in alcohol and forming solution two;

mixing the solution one and the solution two together;

stirring the mixture for approximately 4 hours;

holding the stirred solution under static conditions for approximately 24 hours to form a resultant material;

crushing the resultant material; and

calcining the crushed material at a temperature of approximately 400 to approximately 600 degrees C.

16. The method, as in claim 15, wherein said polymeric steric stabilizer is an organic polymer containing -OH groups or ether groups.

17. The method, as in claim 16 wherein said polymeric steric stabilizer is one of the group consisting of HPC polymer, polyvinylalcohol, ethylene glycol, and hexamethyldisilazane.

18. The method in claim 17, wherein said polymeric steric stabilizer is HPC polymer.

19. The method, as in claim 18 wherein HPC is added in a concentration of approximately 1.0 to approximately 2.0 g/L.

20. The method, as in claim 18 wherein said HPC polymer has a molecular weight of approximately 80,000 to approximately 1,000,000 g/mol.

21. A coating of monodispersed, spherical ZrO_2 particles on a metal substrate, wherein said particles are approximately 10 to approximately 600 nm in size, exhibit metastable tetragonal crystal structure and are 100 % in the tetragonal phase.

22. The coating in claim 21 wherein said coating is pure and free of foreign oxides.

23. The coating, as in claim 21, wherein said particles are approximately 10 to approximately 30 nm in size.

24. The coating, as in claim 21, wherein said particles are approximately 500 to approximately 600 nm in size.

25. Monodispersed, spherical particles of approximately 10 to approximately 600 nm, which exhibit metastable tetragonal crystal structure at room temperature, wherein said

particles are approximately 100% in the tetragonal state, and are composed of a ceramic oxide, and being composed of a single, pure oxide, which is free of other foreign oxides.

26. The monosdispersed spherical particles, as in claim 25, wherein said ceramic oxide is selected from the group consisting of zirconium oxide, tin oxide, titanium oxide and indium oxide.

27. The monodispersed particles, as in claim 25 wherein said particles are of the size approximately 10 to approximately 30 nm.

28. The monodispersed particles, as in claim 25, wherein said particles are of the size approximately 500 to approximately 600 nm.

29. A nanocrystalline ZrO_2 powder, comprising:

monodispersed, spherical ZrO_2 particles of approximately 10 to approximately 600 nm, which exhibit metastable tetragonal crystal structure at room temperature.

30. The nanocrystalline powder in claim 29 wherein said particles are in the approximateley tetragonal phase, and are pure and free of foreign oxides.